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(54) Sterlizing packaging material, e.g. containers made from blanks

(57) Device for sterilizing packaging material, in particular containers 1 made from blanks, has a storage container for a liquid sterilizing medium, e.g. hydrogen peroxide, a nozzle 4 connected to the storage container for blowing the sterilizing medium in an atomized form onto the surfaces of the packaging material to be sterilized, a conveyor device moves the packaging material relative to the nozzle and preceding the nozzle is an ultrasonic atomizer 7 for the sterilizing medium and the nozzle is connected to the mist chamber 6 of the ultrasonic atomizer.

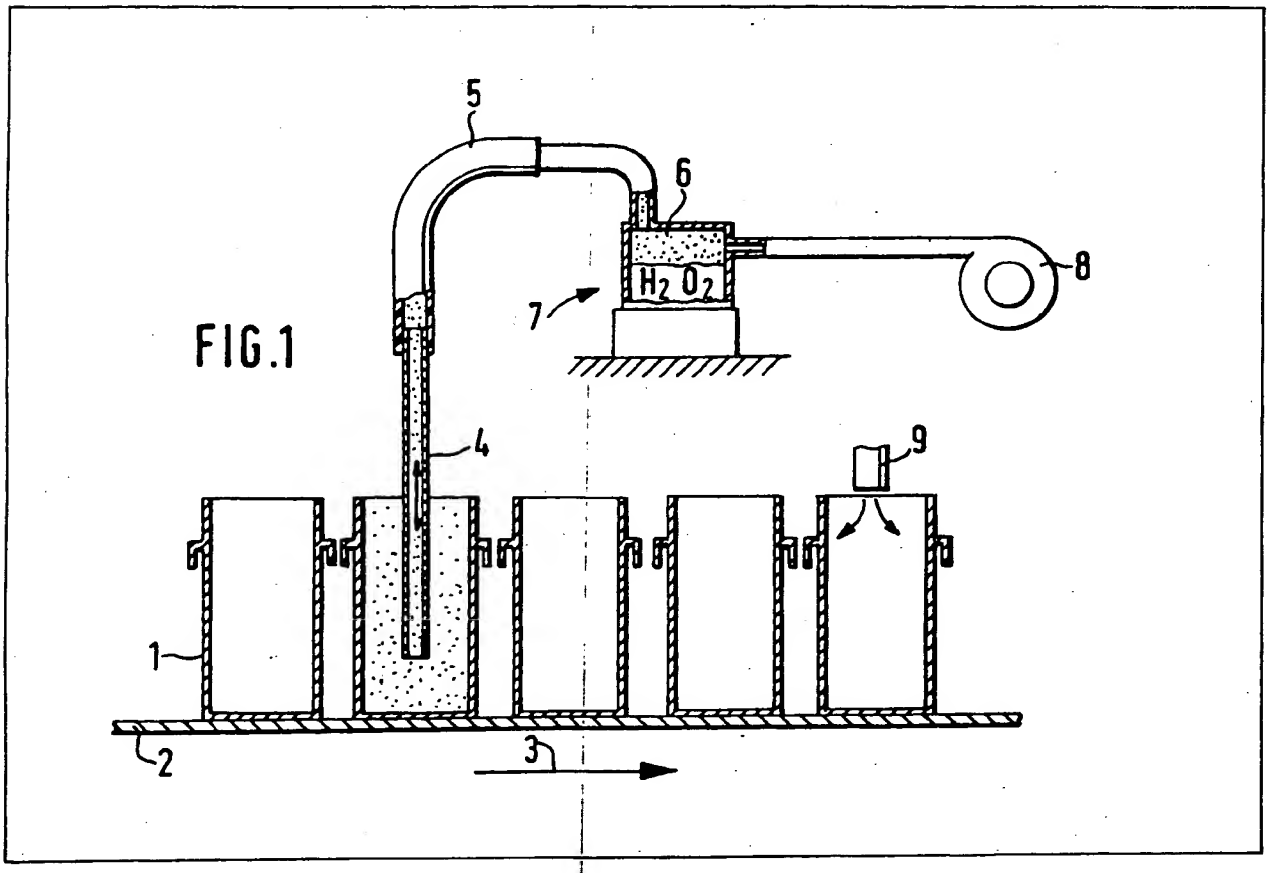

FIG.1

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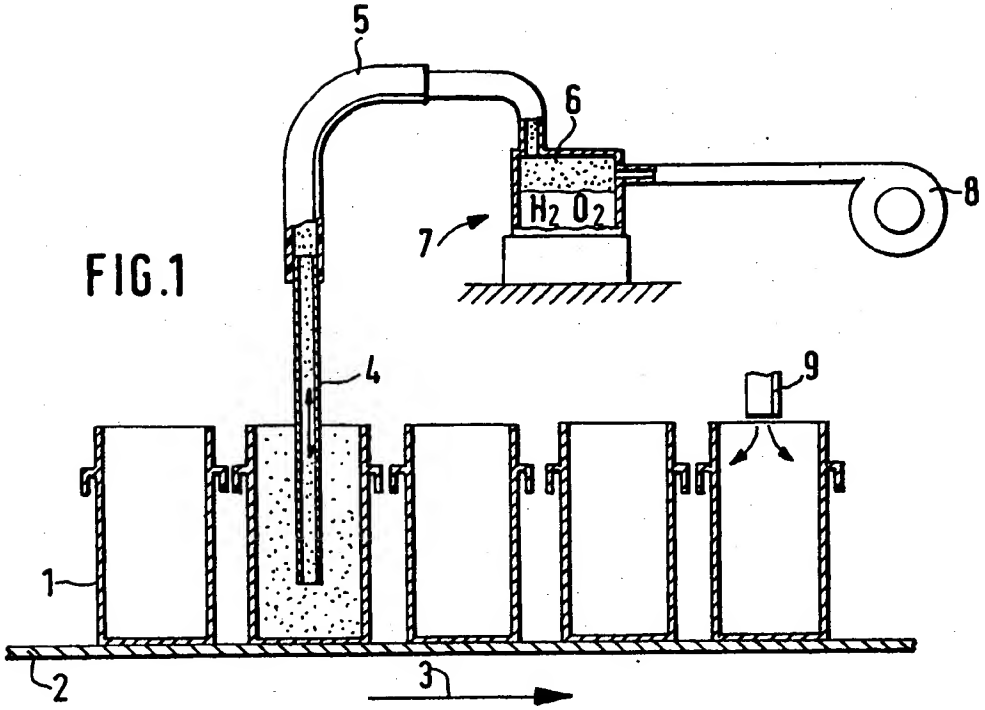


FIG.1

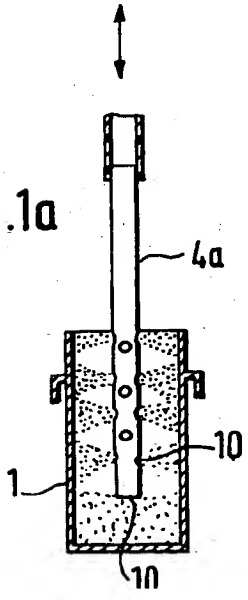


FIG.1a

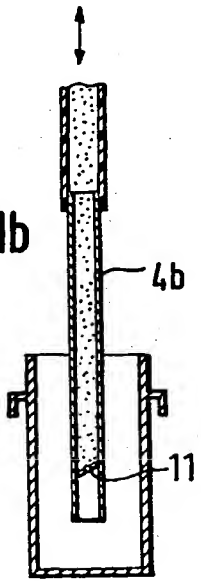


FIG.1b

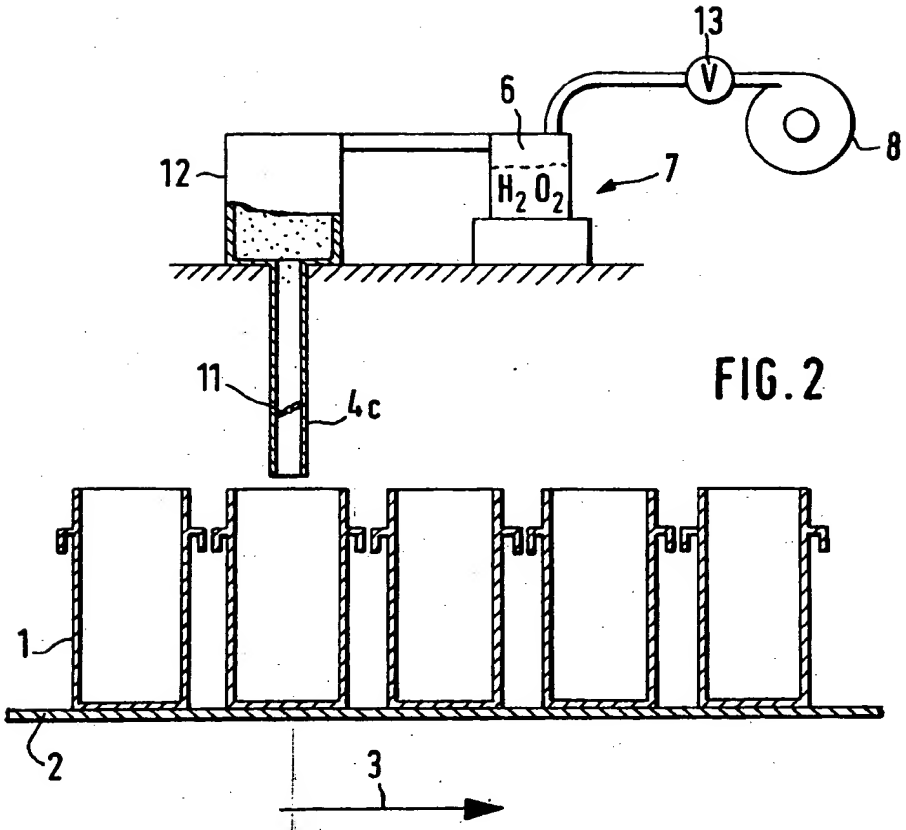
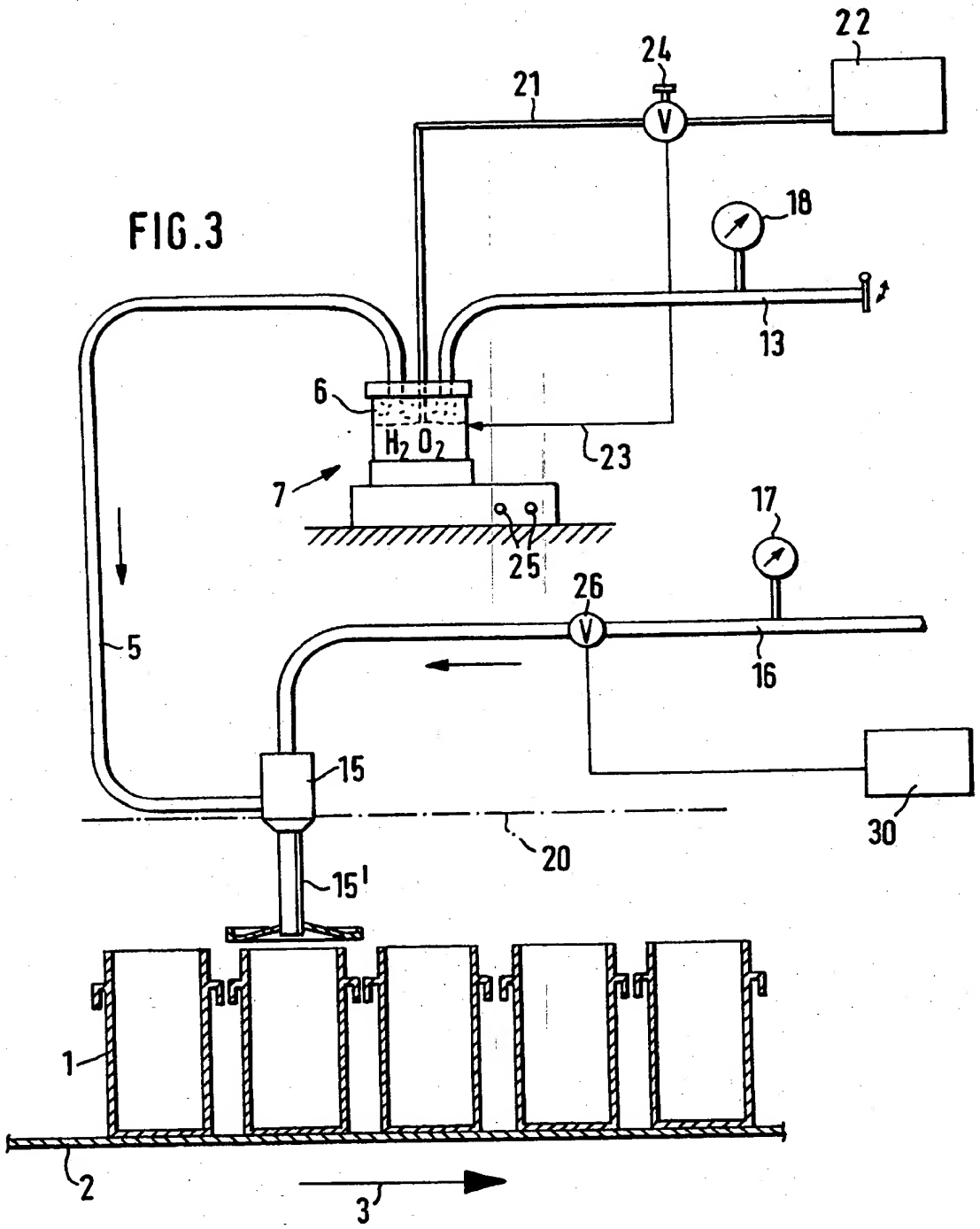


FIG. 2

FIG.3



SPECIFICATION

Method and device for sterilizing packaging material, in particular containers made from blanks

The invention relates to a method for sterilizing packaging material, in particular containers made from blanks, in which a liquid sterilizing medium (bactericide) is atomized and applied in the form of fine droplets to the surfaces of the packaging material to be sterilized. The invention also relates to a device for carrying out the method.

A method and a device of the afore-described type are known (cf for example German AS 18 15 538). In this known method, folding containers for milk or the like made from cardboard blanks are sterilized due to the fact that hydrogen peroxide as the liquid sterilizing medium is atomized inside the folding container by a two-component atomizer nozzle using compressed air. The droplet mist of hydrogen peroxide produced by atomization is deposited on the inner walls of the container and decomposes upon the appliction of heat and also in contact with living organic matter, for example bacteria, into water and atomic oxygen. The atomic oxygen is thus the actual germicide.

This known method and the device for carrying it out have proved quite serviceable in practice. However, they are not free from drawbacks. It has been found that the hydrogen peroxide mist produced by atomizer nozzles has a relatively broad spectrum with regard to its droplet size, in which case the droplet size also varies over the jet cross-section of the atomizer nozzle. This has the result that a uniform film of droplets is formed only in certain regions of the inner walls of the container to be sterilized, which uniform film results in the corresponding uniform sterilization, whereas other regions of the wall are not uniformly coated and also relatively large droplets are deposited, which do not deocompose sufficiently quickly to form water and atomic oxygen. Therefore, in such regions of the container walls, a satisfactory bactericidal action is not guaranteed in every case. Furthermore, relatively large droplets may also remain as a residue inside the container, despite the subsequent hot air treatment. The latter are not in fact injurious to health, since in any case they decompose to form oxygen and water after a shorter or longer period of time. However, irrespective of the nature of the residue, legal requirements with regard to foodstuffs require complete removal of all chemicals, which are introduced into containers for the purposes of sterilization. Therefore, due to the increased consumption of time and energy, the complet removal of large droplets of hydrogen peroxide or of the r sulting water must be nsured.

The atomizer nozzles used for producing the hydrogen peroxide mist are also relatively sensitive and must be operated at high pressure, in order to obtain the desired fineness of the droplets. This means additional expenditure as regards equipment. Pressure fluctuations, which can never be completely prevented, may cause a change in the size of droplet of the hydrogen peroxide mist, which may lead to the formation of larger droplets with the above described drawbacks. Sinc the task of the atomizer nozzle is above all that of atomizing the liquid sterilizing medium and therefore the nozzle plays only a secondary role as regards transportation of the atomized sterilizing medium to the surfaces to be sterilized, in the known method, as regards the deposition of mist in the regions of the wall located outside the actual direction of the jet, one must rely on the fact that the hydrogen peroxide mist forming inside the container moves into these regions and is deposited there. Influencing the latter directly in the sense of a control by corresponding construction of the nozzle is not possible.

It is therefore the object of the invention to propose a method of the afore-described type, which allows completely uniform coating of the packaging material surfaces with the finest droplets of the same order of magnitude of the sterilizing medium, in which case a control of the droplet size should be possible. Furthermore, the object consists in designing and constructing the device intended for carrying out the method in a simpler manner so that irrespective of pressure fluctuations or other influences, the quality of sterilization is not impaired.

According to the invention, the object set is achieved as regards the method by the fact that the sterilizing medium is atomized by ultrasonic atomization to form an aerosol and the aerosol is applied to the surfaces to be sterilized. Preferably, the aerosol is blown-out.

The essential advantage of the method according to the invention consists in that the production of th sterilizing medium mist, i.e. of the aerosol, is independent of the method of appliation of the mist to the surfaces to be sterilized. Therefore, the production of the aerosol on the one hand and the transportion of the aerosol to the surfaces to be sterilized on the other hand can be achieved separately, so that both operations can be carried out in an optimum manner. The droplet size of the aerosol can be controlled by the ultrasonic atomizer (the construction of which is known basically from LUEGER "Lexikon der Technik" [Dictionary of Engineering] Volume 14, 1969) depending on the ultrasonic frequency applied. One obtains droplets of a fineness which cannot normally be achieved with atomizer nozzles. In addition, the droplet size fluctuates only within very narrow limits and the distribution density of the droplets per unit of space is extraordinarily high, so that one can speak of a homogeneous aerosol. It is therefore possible by means of this aerosol, using the smallest quantities of liquid sterilizing medium, to produce a dense and uniform surface coating of the surfaces to be sterilized, which on account of the fineness of the droplets, even with the smallest application of heat, is heated to such a degree that this leads to evaporation or - with the preferred use of hydrogen peroxide - to decomposition.

The aerosol produced by the ultrasonic atomizer is very stable. Therefore, in practice, it can be conveyed like a gas through pipes and blown in a contr lled manner onto the surfac s to be sterilized. Since no pressure is necessary for its production, the

pressure difference necessary for conveyance is sufficient, which will normally be less than the pressure necessary for atomization by means of two-component atomizer nozzles.

As in the afore-described known device for sterilizing packaging material, the device according to the invention also comprises a storage container for a liquid sterilizing medium, a nozzle connected to the storage container for blowing out the sterilizing medium in atomized form onto the surfaces to be sterilized as well as a conveying device for moving the packaging material relative to the nozzle. However, according to the invention it is provided that the nozzle is preceded by an ultrasonic atomizer for the sterilizing medium and the nozzle is connected to the mist chamber of the ultrasonic atomizer.

As a result of the afore-described properties of the aerosol produced by the ultrasonic atomizer, the conveyance of the aerosol to the nozzle and from the latter to the surfaces to be sterilized is very simple. Thus, for example, the mist chamber of the ultrasonic atomizer may be connected permanently to a source of pressure, so that the aerosol produced therein is coveyed either immediately to the nozzle or to a preceding collecting vessel. If the application of the sterilizing medium is to take place cyclically, then a valve controlled cyclically is contained either in the connection between the pressure source and the mist chamber or between the mist chamber and the collecting vessel which is provided if necessary or the nozzle or even in the latter.

A simple blowing tube can be used as the nozzle, which tube is orientated in the direction of the surfaces to be sterilized or which in its end region comprises branches or blowing apertures, which allow the aerosol to blow in different directions. In any case, the blowing apertures, branches or the like will be arranged so that the aerosol can be directed towards all the surfaces to be treated.

In addition to or instead of supplying pressure to the mist chamber and/or the collecting vessel for the aerosol, it is also possible to work with injector nozzles, which draw in the aerosol on account of a flowing, gaseous medium, most appropriately compressed air.

It is appropriate to allow the production of the aerosol by means of the ultrasonic atomizer to take place continuously and to control the supply of the aerosol to the nozzle as required, in the manner already described. In this case it is an advantage to use a collecting vessel which is supplied continuously by the ultrasonic atomizer and to supply pressure to this collecting vessel or to draw off from the latter by means of the injector nozzle, since the formation of the aerosol in the mist chamber of the ultrasonic atomizer is in no way influenced by this.

Further advantages and features of the present invention will becom apparent from the following description of embodiments referring to the accompanying drawings and from the other sub-claims. In the drawings:

Figure 1 shows purely diagrammatically a fundamentally simple embodiment of a device according to Figure 1 as regards the construction of the nozzle;

Figure 2 shows a modified device similar to the construction according to Figure 1 and

Figure 3 shows a further modified embodiment of the device according to the invention.

Figures 1, 2 and 3 each show a device for sterilizing folding containers produced from cardboard blanks, which are to be filled with milk for example. Only the parts which are essential to the present invention are shown diagrammatically in the drawings. The remaining parts of the installation, for example for forming the folding containers, for filling them and sealing them are not illustrated since they do not belong to the invention. However, in this respect, the device can be constructed for example according to that of the aforementioned German AS 18 15 538.

According to the illustration of Figure 1, folded containers 1 are moved cyclically by a conveyor device, for example a bucket chain (not shown) along a table 2 in the direction of arrow 3. An immersion tube 4 which is able to move up and down is located as the blowing nozzle above the path of movement of the open upper side of the folded containers 1 by means of devices which are not shown but are known per se. The blowing nozzle 4 is connected by a connecting line 5 to the mist chamber 6 of an ultrasonic atomizer designated generally by the reference numeral 7. Liquid hydrogen peroxide is located to a certain level above the base of the mist chamber 6. The filling level of the hydrogen peroxide in the mist chamber 6 can be maintained continuously by a storage container (not shown) and by means of filling level control devices known per se. It will be understod that the output of the ultrasonic atomizer is designed so that the quantity of aerosol produced by the latter per unit time is coordinated with the requirements represented by the capacity of the containers 1 and the cycle time of the installation.

In the embodiment, oil-free compressed air is supplied to the mist chamber 6 by a pressure source 8, which can be a compressor, fan or the like for example.

In the simplest embodiment according to Figure 1, a hydrogen peroxide aerosol is produced continuously by the ultrasonic atomizer 7 in its mist chamber 6, whereof the droplet size and density depend on the power input and frequency of the ultrasonic atomizer 7. Due to the continuous supply of compressed air, the aerosol is conveyed from the mist chamber 6 according to the conveying capacity of the pressure source 8 through the line 5 to the blowing nozzle 4. If a container 1 is located below the blowing nozzle 4, then the blowing nozzle 4 is introduced into the inside of the contain r due to the fixed-cycle control, so that the scaping aerosol escapes directly above the bottom of the container and is forc d upwards according to the throughput of the pressure source 8.

Due t this, the base and walls of the container 1 are coated with a uniform film of the finest aerosol

container. The conveyor device moves the treated container 1 in the direction of arrow 3, in which case in the embodiment illustrated, this container is subject to the action of the aerosol mist during two cycle times. During this time and in particular during the subsequent hot air treatment by means of a hot air nozzle, when hot air at a temperature of approximately 200°C is blown into the inside of the container, the fine and very fine aerosol droplets of hydrogen peroxide decompose into water and atomic oxygen, the atomic oxygen bringing about sterilization. As a result of the dense and uniform distribution of equal-sized droplets on the inner surfaces of the container, satisfactory sterilization is achieved. Furthermore, since the droplets are very fine and therefore only a small quantity of heat is required to heat them, the container is dry and sterile after the hot air treatment by means of the hot air nozzle 9.

The embodiment according to Figure 1a shows a blowing nozzle 4a, the end of which does not open out with the full cross-section of the tube, but has solely a small blowing aperture. However, blowing apertures 10 pointing in all directions are provided in the end region of the blowing nozzle 4a over the height by which the latter is immersed in the container 1. Individual aerosol jets can be directed at the bottom of the container and the side walls of the container through the blowing apertures 10, so that the deposition of aerosol droplets on the surfaces treated can be controlled.

The blowing nozzle 4b according to Figure 1b corresponds to that of Figure 1. However, in its end region, it comprises a closing flap 11, which serves as a closing valve and is controlled by an actuating device (not shown), in timed sequence with the entire installation. Hydrogen peroxide aerosol is thus prevented from flowing out during the time when the blowing tube 4b is located in the raised position.

The device according to Figure 2 corresponds as regards its essential construction to that of Figure 1. Therefore, identical parts are designated by the same reference numerals. One difference is that the blowing nozzle 4c is arranged in a stationary manner above the containers 1 moving forwards therebelow and is connected to a collecting vessel 12, which is in turn connected to the mist chamber 6 of the ultrasonic atomizer 7. A restriction valve 13 is incorporated in the pressure line between the mist chamber 6 and the pressure source 8. A controlled closing valve 11 is once more provided in the blowing nozzle 4c in accordance with the construction according to Figure 1b.

The collecting vessel 12 has a much greater volume than the mist chamber 6. It is under same pressure which prevails in the mist chamber 6. Th existing pressure cushion is sufficient during th opening time of the closing valve 11 in the blowing nozzl 4c to blow a pr determined quantity of hydrogen peroxide aerosol into the insid of the container 1 located therebelow. Owing to the volume of the collecting vessel which is much larger than that of the mist chamber 6, the pressure in the collectina vessel drops only slightly during this period of time. The pressure loss is compensated for after closure of the closing valve 11 by the continuously operating pressure source 8.

In the embodiment according to Figure 3, in place of a simple blowing nozzle, an injector nozzle 15 with a blowing tube 15', is used, which comprises a suction chamber not shown in detail, which is connected to a venturi tube or a similar discharge nozzle. A pressure medium, in the present case oil-free compressed air flows through the venturi tube, the said compressed air being supplied through a pipe 16 by a pressure source (not shown). A pressure meter 17 is incorporated in the line 16. Leading to the suction chamber of the injector nozzle 15 is the connecting line 5 for the hydrogen peroxide aerosol produced in the mist chamber 6 of the ultrasonic atomizer 7. In addition, as in the aforedescribed other embodiments, oil-free compressed air is supplied to the mist chamber 6 by the pressure line 16, in which a pressure meter 18 is incorporated for the purpose of checking and possibly control.

Due to the joint action of the supply of pressure to the mist chamber 6 and the drawing-off by the suction of the injection nozzle 15, the aerosol is conveyed by way of the connecting line 5 to the nozzle 15 and blown out of its opening together with the conveying compressed air from the line 16. Since the aerosol is very stable, it is not subject to any changes due to the suction and blowing operation. The blowing tube 15' of the injector nozzle 15 produces a certain jet encompassing the inner walls and base of the container. The injector nozzle 15 is arranged in a stationary manner above the path of movement of the containers 1 and for example is fixed in a shield 20, which covers the sterilizing station of the installation. It can also be arranged to be raised and lowered.

The ultrasonic atomizer 7 is supplied continuously by way of a line 21 from a storage container 22 for hydrogen peroxide. In conjunction with a valve 24, a filling level monitoring arrangement 23 controls the filling level in the mist chamber 6.

Setting knobs 25 are shown on the ultrasonic atomizer 7, which knobs facilitate an adjustment of the ultrasonic atomizer 7 to the desired oscillation amplitude and frequency. Thus, the droplet size and distribution of the aerosol can be selected in coordination with the characteristics of the injector nozzle 15, which leads to the intended fine covering of the inner surfaces of the container with the film of droplets.

It will be understood that the conveying compressed air is supplied from the pipe 16 to the injector nozzle 15 in synchronism with the machine cycle of the entire installation, so that the injector nozzle 15 sprays aerosol within one cycle time. The supply of the conveying compressed air is controll d for example by a valve 26 in the line 16 by the overall control arrangement 30 for the installation (shown only diagrammatically).

The screen 20 may comprise extraction means (not shown) for aerosol present inside this screeen, which extraction means return the aerosol to the storage container 22. In th embodiment according to Figure 2, the c ll cting vessel 12 may als b

provided with a return line to the storage container, by which hydrogen peroxide deposit on the walls of the collecting vessel 12 can be returned.

The compressed air supplied by the line 16 can be warmed or heated, so that due to this the hydrogen peroxide aerosol, which is drawn in through the injector nozzle 15, is also heated as a result of mixing. Due to this, the lethality of the bacteria to be destroyed is increased and condensation of the hydrogen peroxide inside the injector nozzle 15 or in the blowing tube 15' is prevented.

CLAIMS

1. Method for sterilizing packaging material, in particular containers made from blanks, in which a liquid sterilizing medium is atomized and applied in the form of fine droplets to the surfaces of the packaging material to be sterilized, wherein the sterilizing medium is atomized to form an aerosol by ultrasonic atomization and the aerosol is applied to the surfaces to be sterilized.

2. Method according to claim 1, wherein the aerosol is blown onto the surfaces to be sterilized.

3. Method according to claim 1 or 2, wherein after is production by ultrasonic atomisation, the aerosol is firstly collected in a collecting vessel and then sucked from the latter or expelled therefrom.

4. Method according to any one of claims 1 to 3, wherein hydrogen peroxide is used as the sterilizing medium.

5. Method according to any one of claims 1 to 4, wherein after the application of the aerosol to the surfaces to be sterilized, these surfaces are dried by a heat treatment.

6. Device for sterilizing packaging material, in particular containers made from blanks, with a storage container for a liquid sterilizing medium, a nozzle connected to the storage container for blowing the sterilizing medium in an atomized form onto the surfaces of the packaging material to be sterilized and with a conveyor device for moving the packaging material relative to the nozzle, wherein preceding the nozzle is an ultrasonic atomizer for the sterilizing medium and the nozzle is connected to the mist chamber of the ultrasonic atomizer.

7. Device according to claim 6, wherein an aerosol collecting vessel is incorporated between the nozzle and mist chamber of the ultrasonic atomizer.

8. Device according to claim 6 or 7, wherein the mist chamber of the ultrasonic atomizer is connected to a pressure generator.

9. Device according to any one of claims 6 to 8, wherein the mist chamber and/or the collecting vessel are constantly under pressure and a valve is located in the connecting line from the mist chamber or from the collecting vessel to the nozzle and/or in the nozzle.

10. Device according to any one of claims 6 to 9, wherein the nozzle is a blowing tube.

11. Device according to claim 10, wherein for sterlizing containers the nozzle is an immersion tube able to be introduced into the inside of the

end of the immersion tube associated with the inside of the container comprises lateral blowing apertures.

13. Device according to claim 12, wherein the size of the blowing apertures can be coordinated with the surfaces to be treated.

14. Device according to any one of claims 6 to 8, wherein the nozzle is an injector nozzle connected to a compressed air line, the suction chamber of which nozzle is connected to the mist chamber of the ultrasonic atomizer or to the aerosol collecting vessel.

15. Device according to claim 14, wherein the injector nozzle receives warm or hot air by way of the compressed air line.

16. Method for sterilizing packaging material, substantially as herein described with reference to the accompanying drawings.

17. Device for sterilizing packaging material, substantially as herein described with reference to and as illustrated in the accompanying drawings.

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